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reaction-time for different parts of the body. In this review of the literature, the criticisms of method are pointed out in every study, one of the chief criticisms being that the two paths chosen have not been directly comparable. The author obviates this difficulty by his choice of conduction pathways. A visual stimulus makes use of the fact that stimulation of the right side of both retinas goes to the right cuneus; while stimuli falling on the left side of either retina go to the left cuneus. Thus a direct pathway may be obtained from the cuneus on one side with the motor area on the same side and a reaction with the opposite hand; and an indirect pathway is obtained if the subject reacts with the hand on the same side as the cuneus stimulated. The only difference between the direct and the indirect pathways would be a commissural cell in the brain or cord and thus the introduction of another synapse. The apparatus consisted of a Froeberg exposure wheel connected with a Hipp chronoscope. The fixation was ingeniously obtained by introducing a modified perimeter into the experimental arrangement. On the basis of 10,000 reactions, obtained with various angles of peripheral vision, the author concludes that a very definite time is required for the passing of nervous excitation over a synapse, since the reaction-times for the indirect pathways are uniformly greater than those for direct pathways. Certain objections were raised by the author; their influence was ascertained by means of test experiments, and on this basis they were either allowed for or rejected.

One is impressed by the fact that this study shows great care and ingenuity of experimental arrangement; one can not but feel, however, that it is based on a rather uncertain foundation of anatomical and physiological hypothesis. However, if these hypotheses are valid,—and this very study may give another indication that they are,—the author has made a positive contribution to psychological knowledge.

Clark University,

SAMUEL W. FERNBERGER.

Influence and Adaptability. An Experimental study of their relation, with special reference to individual differences. By ARTHUR JEROME CULLER, Ph. D. Arch. of Psychol., No. 24. (Columbia Cont. to Phil. and Psychol. Vol. XXI, No. 2.) New York, 1912. v + 80 pp.

As the title indicates, this study deals with individual differences in the general field of interference between two conflicting associations, and with the adaptability of the subject by means of which the reactions to both become automatic. Interference may be of two types: 1. When one association is well established before another is introduced into consciousness; and 2. when two mutually opposing associations are alternated. Several variations of experimental arrangement were employed in order that both types of interference might be investigated; and as the study was primarily one of individual differences a large number of subjects were used.

In one form of experiment the subject associated certain fingers with the pressing of certain typewriter keys; and after this habit was well established, he changed the relation of keys and fingers. In another form of experimentation, he reacted with right and left hand to stimuli of different colors, the time being recorded by means of a Forbes chronoscope. These, however, seem to be considered by the author as preliminary experiments and not of the value of his later work. The latter consisted in a variation of the Bergstrom

card-sorting experiment, and was performed on thirty-four subjects, half of whom were men and half women.

From his results he concludes that interference occurs for all subjects; but it decreases with practice, and finally the reactions to both associations become so automatic that either may be called up without the appearance of the other. As regards his real problem, the author finds great individual variations in the rate of improvement, or in the actual time records. He finds no significant sex differences in the rate of improvement or in the absolute time records. The women show great variability, however, in the recurrence of the old or wrong associations.

This paper seems to be too general in its form and in the method of collecting data to be of value. For example, the author shows a positive correlation between adaptability and the traits of individuality, independence and originality, and the measure of these latter is obtained by an averaging of the opinions of twelve friends of the subjects expressed in numerical terms. The author includes several figures, but these contain so many curves that it is almost impossible to follow out any single one of them.

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Reaction to Multiple Stimuli. By JOHN WELHOFF TODD, Ph. D. Arch. of Psychol., No. 25. (Columbia Cont. to Phil. and Psychol. Vol. XXI, No. 3.) New York, 1912. iii + 65 pp.

The author studied reaction-times to multiple stimuli presented simultaneously,—light, sound, and an electric shock being used and the time recorded with a Hipp chronoscope. These stimuli were presented singly, in pairs, or in groups of all three, and it was found that presenting the stimuli in pairs resulted in a shorter reaction-time than that of either stimulus presented singly. If all three stimuli were given simultaneously, a still further reduction resulted. It was ascertained that the reaction-time to sound was usually the most rapid, that to light the least rapid; and it was further found that light in combination with either of the other stimuli had the least facilitative effect, while sound had the greatest.

A certain group of reactions were taken to discover if the subject could pick out one stimulus from the complex and react to it; but it was found that this did not give different results from those of the same complex as a whole. An experimental arrangement was then used for reaction to successive stimuli with varying intervals between them, the reagent always reacting to the last one. The results show that this arrangement increases the time of reaction, but this lengthening of the reaction-time decreases as the interval is shortened.

This latter phenomenon is explained by the author in terms of inhibition. The reduction of reaction-time to multiple stimuli is explained in terms of summation of stimuli which can then cross the synapses between the neurones more rapidly than the single stimulus. This is considered to be a further proof of the validity of Cattell's view that the reaction event is a cerebral reflex, and the author cites similar reinforcements in the general field of reflex movement.

This is a very suggestive study, both in regard to the data which it presents in a comparatively unworked field, and as regards the problems which it raises for further research.

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